Washout and Non-Washout Solutions of A Microbial Fermentation Model Under the Influences of Growth Inhibitions and Maximal Cell Density

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An unstructured model for the growth of yeast cell on glucose is discussed. Growth inhibitions by substrate, product, and cell density as natural phenomena for cell growth are taken into consideration. The proposed model describes the dynamical behavior of fermentation system that reveals multiple steady states and oscillatory behavior in a certain regime of operating parameters. Two types of steady state solution are found, namely washout and non-washout solutions. There exists a certain pair of inlet glucose and dilution rate values at which the washout solution may be avoided. For the non-washout solution, three regimes for its stability behavior are found: regime with unique stable steady state, unique stable steady state with oscillatory behavior, and regime with multiple steady states and possible oscillatory behavior. High carrying capacity expands the non-washout steady state domain with and without oscillatory behavior. There is an optimal inlet glucose which produces the highest cell and ethanol concentration. There is also a critical inlet glucose at which feeding glucose which is greater than the critical one leads the system to the washout solution.

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